CENTER for SCIENCE in PUBLIC PARTICIPATION

PO Box 1250 Chickaloon, AK 99674
Phone (907) 354-3886 / web: www.csp2.org / e-mail: kzamzow@csp2.org
"Technical Support for Grassroots Public Interest Groups"

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Office of Environmental Information (OEI) Docket (Mail Code: 2822T)
Docket # EPA-HQ-ORD-2012-0276
US EPA
1200 Pennsylvania Ave, NW
Washington, DC 20460
ORD.Docket@epa.gov

Re: Comments on Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska

From: Kendra Zamzow, PhD

The Center for Science in Public Participation is a non-profit corporation that provides technical advice to public interest groups, nongovernmental organizations, regulatory agencies, mining companies, and indigenous communities on the environmental impacts of mining. CSP2 specializes in hard rock mining, especially with those issues related to water quality impacts and reclamation bonding.

All mines impact the environment. In exchange, they provide national or global benefit. The risk assessment provided by the EPA in "An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska" (Assessment) provides excellent, well-researched, and well-documented information on potential impacts, and should be considered an essential document if and when a mining permit is submitted for a large scale copper mine in the region. It provides, in fact, a conservative approach by focusing only on the most likely impacts of a large scale copper mine on a wetland environment – copper and sediment. The Assessment does not provide new research, but considers the extensive baseline work done by the Pebble Limited Partnership (PLP), as well as work by other scientists within and adjacent to Bristol Bay mining leases. It puts the data in context. Rarely does a risk assessment prior to a project examine so closely impacts to a key ecological driver -- in this case, salmon.

In my comments below, I point out some areas that could be improved, as well as subjects that I thought were approached well. I focus on water quality issues. This letter summarizes topics, and is accompanied by an Excel sheet to track topics, sections, discussion, and citations.

Ambient water quality

The waters in the Nushagak-Kvichak area targeted by large scale mining are of extraordinary quality and generally better than Alaska water quality criteria (PLP 2012; Zamzow 2012; Zamzow 2011). Discharges that meet all water quality criteria will cause downstream water quality to be lowered.

1. Add to make more complete. The high quality of water in the area could be more fully indicated by moving Table 5-17 to Chapter 2, and by expanding the list of analytes with baseline data (available in PLP 2012 and Zamzow 2011).

2. Add to make more complete. Add a column(s) in Assessment Table 5-17 that show the most stringent water quality criteria, noting which are based on aquatic life criteria (ADEC 2008).[1] An example can be found in Ghaffari et al 2011, Table 18.3.4.

3. Add to make more complete. End of pipe discharges from a water treatment plant that fully meet all current Alaska water quality criteria would result in lower water quality than currently exists. The concentration of copper in ambient waters is often < 0.5 ug/L (PLP 2012; Zamzow 2012; Zamzow 2011), while hardness-based water quality criteria for discharge water is likely to be near 2.5 ug/L (ADEC 2008). Under a No-Failure scenario, aquatic life could still potentially be exposed to higher concentrations of copper than it currently is.

4. Comment on relevancy. Sections 5.3.2.2 and 6.1.4.4 note that the water quality criteria used in the Watershed Assessment may not be protective of all macroinvertebrate taxa. Given the high quality of ambient water, this is relevant.

   "Studies of streams receiving mine effluents and laboratory studies suggest that the abundance of important insect taxa could be reduced ***even if criteria are met***." *(Assessment Section 5.3.4)*

<u>Conceptual Models</u>

The conceptual models clearly demonstrate potential contaminant source – path – receptor routes with defined biotic response endpoints. These provide the basis for research supporting risk assessments. Areas that could use improvement are listed below.

1. Change to make more accurate. A conceptual model should combine 3.2-A (Habitat, Operations) and 3.2-B (Water, Operations) into a model "Habitat and Water, No Failure" to support the text of Chapter 5. Model 3.2-A would remain essentially the same, but some pathways in 3.2-B would be eliminated and would remain only in models 3.2-C (Water and Habitat, Closure) and 3.2-D (Water and Habitat, Failure). Figure 3.2-D (Habitat and Water, Failures) should have Failure pathways added for "Waste Rock" and "Housing Construction".

2. Comment on clarity. A "walk-through" narrative might better explain the conceptual models. For instance, it is not at all intuitive why certain metals (e.g. Hg, Se) would increase under the different model scenarios for Assessment Figures 3.2-B and 3.2-C; they do not appear to come from discussions of waste rock and tailings leachate or any other obvious source. Nor is it clear why strong components of leachate (e.g. Al, Cd) are not listed.

3. Change to make more accurate. In Assessment Figure 3.2-A, is a box for "Increased inter-basin water transfers". Under the minimum mine size, with tailings stored in the North Fork Koktuli valley, it is not clear how there will be inter-basin water transfer; such transfer has only been documented between the South Fork Koktuli and Upper Talarik Creek (PLP 2012). This comment also applies to Assessment Figure 4-9, a nice diagram but it suggests water could flow to/from the pit lake to the tailings facility, which is not plausible under the minimum size scenario.

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[1] Although the most stringent water quality criteria are generally found in the "use" categories of aquatic life, criteria can be more strict in other "use" categories, e.g. arsenic within the "use" of drinking water, manganese within the "use" of human consumption of water + organic organisms, etc.

4. Comment on presentation. The models could be printed on fold out sections for easier viewing in print format.

Mine Scenario

The mine scenario is set up well, with the exception of data gaps in discussion of water treatment and underground mining. These data gaps deserve fuller discussion, provided in separate sections after the "Mine Scenario" comments below.

1. Add to make more complete. The "identities of ore processing chemicals are unknown, so potential toxicity is not considered" ("Uncertainties", Assessment Section 5.3.4) EPA is setting up a hypothetical mine scenario, and includes chemical "storage and transport" in the conceptual models. Ghaffari et al 2011 Sections 16.4.3 and 16.9.4 mentions specific chemicals that will likely be utilized at Pebble, and it is reasonable to assume they would also be used at other mines. It is worth providing a list of likely chemicals. Limiting the risk assessment by not including the chemicals again underscores the conservative approach of the Assessment.

2. Comment on relevancy. The mine scenario contains a good description of why dry stack tails are not likely to be used (Assessment Section 4.2.3, Table 4-4), which helps to explain why a tailings impoundment will be needed. Noting the issues with the Greens Creek mine dry stack tailings (Chapter 7), which had re-saturation issues, is also helpful in assessing options for tailings management.

3. Comment on relevancy. The scenario of placing a liner on the tailings dam face, but not covering the entire bottom of the tailings facility, is appropriate and realistic.

4. Comments on presentation.
    a. Good visual of ore processing (Assessment Figure 4-4)
    b. The figure of the tailings dam (Assessment Figure 4-8) could include comparison to dams at mines in Alaska (e.g Fort Knox, 111m, Red Dog 63m; Levit and Chambers 2012), or common Alaska landmarks (Conoco-Phillips Building 90m, Atwood Building 81m; www.emporis.com).
    c. A legend should be placed on each of the conceptual model figures
    d. Assessment Section 4.3 references Table 4-4, a comparison of a Pebble-sized mine to other mines in Alaska. Another table should be developed that compare the ore body to global copper porphyry mines, former and existing (Cooke and Hollings 2006; www.resourceinvestor.com/2010/06/28/sizing-up-the-worlds-mega-coppergold-projects)

Water Treatment

There is a data gap concerning Water Treatment. Despite discussions of mine/waste facility sizes and details, there is no discussion of water treatment plant options and methods, outside of a very cursory summary in Appendix I. While the Northern Dynasty report that much of the Assessment details are drawn from (Ghaffari et al 2011) is weak on details of a water treatment plant, a plant is essential to the operation of a mine, and the broader subject should be discussed in Appendix I.

1. Add to make more complete. A discussion of water treatment options is warranted to allow the reader to understand constraints (EPA 2006a). This should include a discussion of

passive treatment (EPA 2006 Section 4.2.3; EPA 2006b). While passive treatment was mentioned in Appendix I[2], this method is not an option at a large scale sulfide mine, which will have high flows and metal concentrations much too large for passive treatment to handle.

2. Comment on presentation. Assessment Section 4.3 mentions that water quality in operations will be a mix of mill slurry supernatant, background (represented by the North Fork Koktuli) and oxidation leachate, and references the reader to Assessment Appendix H. The tables in Appendix H should be summarized in tables or boxes in this section.

Failure scenarios

1. Tailings.
    a. Comment on relevancy. If a tailings facility seepage failure occurs due to abandonment of the site, but after the tailings facility has been drained down, the tailings could experience wetting/drying cycles similar to the conditions in humidity cell testing. Therefore using the humidity cell test results in an exposure-response assessment (Assessment Chapter 6.3.3) is reasonable.
    b. Comment on relevancy. The use of dam failures at other sites to indicate the potential exposure (but not the probability) of a failure is a good use of these examples (Chapter 3.5, Chapter 6). Mitigation works until it doesn't, at which point the resulting impacts on the environment are the same whether "state of the art" or "old" techniques were used to develop the mitigation.

2. Tertiary Waste Rock. Assessment Chapter 6 refers to Tertiary waste rock as "neutral". This underestimates the risk of rock that could be used in construction materials.
    a. Change to make more accurate. PLP data shows that some Tertiary rock is PAG (Day and Linklater 2012)
    b. Comment on relevancy. Tertiary rock leachate exceeds aquatic life criteria for cadmium and copper (Assessment Table 5-14). If used in construction material or placed without cover on the surface, this rock could experience wetting/drying cycles similar to the conditions of humidity cell tests. It is reasonable to use humidity cell tests to conclude that leachate collection failure would result in acute and chronic toxicity (Assessment Section 6.3.3).
    c. Comment. Tertiary rock leachate has concentrations that meet water quality criteria but are higher than ambient water (as means, Assessment Table 5-14) for sulfate, aluminum, arsenic, molybdenum, barium, calcium, magnesium, potassium, sodium, manganese, nickel and zinc. Un-collected leachate that meets water quality standards could still degrade waters from their present condition.

3. Pre-Tertiary Waste Rock. Assessment Chapter 6 discusses the potential impact of copper on aquatic life should waste rock leachate collection systems fail.

[2] "Stormwater from disturbed areas and mining wastewater is treated via either active or passive methods prior to being used in the mining process or released into a water body….. Wetlands are an example of a commonly used passive treatment system for water contaminants at mining sites, as are anaerobic biochemical reactors (also called sulfate-reducing bioreactors). Although they can be used during the operational phase, passive treatment systems are most commonly used post-closure." (Appendix I, Section 6.1)

a. Comment. All waste rock, based on leachate results, has the potential to release high concentrations of copper and therefore significantly impact aquatic life if collection systems fail (Day and Linklater 2012).
b. Comment. The leachate collection Failure scenario underestimates risk. In addition to copper, aluminum and cadmium exceed aquatic life standards (Assessment Tables 5-15 and 5-16) in Pre-Tertiary waste rock.
c. Comment. The scenario underestimates risk. Pre-Tertiary rock leachate has concentrations that meet water quality criteria but are higher than ambient water (as means, Assessment Tables 5-15 and 5-16) for sulfate, arsenic, molybdenum, potassium, iron, and manganese than are found in ambient waters. Leachate that meets water quality standards could still degrade waters from their present condition.

4. Add to make more complete. Mine Pit. Appendix I, Section 3 regarding the open pit contains no "Closure" section. There is no assessment of pit lake water quality other than the statement "modeling can assist in identifying if a pit lake will become acidic at closure". Parts of Assessment Section 4.3.8.1, which has some discussion of pit wall chemistry, could be reiterated in Chapter 6/Appendix I, with mention that pit lake water quality can be difficult to predict (Gammons 2009).

5. Comment on relevancy. Discussion of the failure to meet NPDES Permit water quality standards at Red Dog (Assessment Section 6.3.3) is relevant. This section should mention that Red Dog continues to deal with high total dissolved solids, and, based on Tables 5-14 to 5-16, 6-2, and 6-3 this is likely to be an issue at the hypothetical mine in the Assessment as well (Clark 2011).

6. Add to make more complete. Underground mine. There is a data gap with regards to discussion of long-term risks at an underground mine. Underground mining is covered in detail in the Northern Dynasty report that many Assessment details were drawn from (Ghaffari et al 2011, Sections 1.7.2, 18.1.2, and 20.2.3), noting that

> *"…underground mining (in particular, block caving) remains an economically viable option at long-term metal prices for developing the deeper and higher-grade resources in the eastern portion."* (Ghaffari et al, 2011, Section 1.1.3)
>
> *"It should be noted that mine development at Pebble following the initial 25 years of production could be undertaken via underground block caving."* (Ghaffari et al, 2011, Section 1.7.2)

The discussions provide a basis for EPA to evaluate potential risks underground mining poses to salmon habitat. While the short term risks might be similar to open pit mining (waste rock, tailings), the long term risks are different (Woo et al 2009; Chambers 2008; Blodgett and Kuipers 2002). Extensive underground mine workings, particularly those developed through block caving, pose the risk of subsidence, and the creation of pathways through which water in flooded mine workings could reach the surface. It seems reasonable to assume the water in underground workings would be similar to Pebble East waste rock leachate. In the Assessment, although underground mining is shown in conceptual models, there is only a brief mention of an underground mine as providing a "smaller footprint" (Assessment Section 4.2.1, Section 4.3.3). Although Appendix I (Section 4.0) discusses backfilling mine workings in order to reduce the risk of subsidence, the block caving method does not allow for backfilling (because workings are filled with rubble) and leaves the area vulnerable to subsidence effects. Similar to the mention of "passive treatment" in Appendix I, a fuller discussion is warranted.

Organizational

Some small organizational changes are suggested.

1. There is an incorrect citation. Section 5.3.2 contains a quote on copper concentrations ("However, most of the exceedences were…") that is not from the reference PLP 2011, Figure 9.1-35 – which is actually a figure of hardness in North Fork Koktuli waters.
2. Incorrect reference. Section 6.3.1 discusses Tertiary rock leachate and references Table 5-12; it should reference Table 5-14.
3. The discussion of Waste Rock leachate in Chapter 5 (Risk Assessment: No failure) should be in Chapter 6 (Risk Assessment: Failure), with the discussion of tailings supernatant. Under a No Failure scenario, it would be presumed that all discharge water would meet Alaska water quality criteria, regardless of source.
4. Table 5-17 (Background Surface Water Characteristics) would fit better in Chapter 2 (Characterization of the Current Conditions) than in Chapter 5.

The mine scenario developed is realistic and well-researched. The approach is conservative, and provides a "No Failure" scenario that presumes all mitigation works for the entire life cycle of the mine – an unrealistically optimistic option -- to contrast with various failure scenarios. While a few sections could use more discussion, expanding these sections would not serve to reduce or diminish the risks; in fact, they again highlight the conservative nature of the report. Based on my review, a large scale sulfide mine in the Nushagak-Kvichak watershed poses certain, unacceptable, adverse effects on a salmon ecosystem, even should the mine employ best practices and have no accidents or failures over the life of the mine. Within the real world of winds, freezing temperatures, human error, and mechanical failures, the actual adverse effects can only be greater, not less, than outlined in the Assessment.

I appreciate the opportunity to comment on this draft Assessment.

Regards,

Kendra Zamzow

Kendra Zamzow, PhD

<u>Attachments</u>

Excel sheet of points and references

Compressed folder, references for Ambient Water Quality comments

- Zamzow 2011
- Zamzow 2012
- ADEC 2008
- Agar et al 2010

Compressed folder, references for Mine Scenario comments

- Levit and Chambers 2012
- Cooke and Hollings 2006

Compressed folder, references for Water Treatment comments

- EPA 2006a
- Younger 2002
- Younger 2000
- EPA 2006b

Compressed folder, references for Failure comments

- Day and Linklater 2012
- Mebane 2006
- Bowen et al 2006
- Farag et al 1993
- Southwest Hydrology 2002
- Gammons et al 2009
- Clark 2011
- Woo et al 2009
- Blodgett and Kuipers 2002
- Chambers 2008